NERL Research Abstract

EPA's National Exposure Research Laboratory
GPRA Goal 8 - Sound Science
APM # 665

Significant Research Findings

National Human Exposure Assessment Survey

Scientific Problem and Policy Issues

During daily activities, people come into contact with chemicals through a variety of pathways, such as water, food, air, soil, and dust. Different types and quantities of chemicals may be present in the various locations where people spend time each day. In order to understand the risks of exposures to chemicals, and to identify and reduce possible sources of these exposures, the contributions from each of these locations and pathways need to be understood. The need to understand all of the pathways and routes by which people are exposed has been reinforced by recent legislation (for example, the Food Quality Protection Act [FQPA] of 1996) requiring EPA to consider the "aggregate" human exposure to pesticides and other toxic chemicals. Aggregate exposure refers to the total exposure of humans to chemicals through all relevant pathways and routes. Actual data on what people are exposed to is critically needed to reduce the uncertainties inherent in estimating exposures from all relevant pathways and routes.

Research Approach

The National Human Exposure Assessment Survey (NHEXAS) studies measured distributions of human exposures to a variety of high-risk target chemicals, including metals, volatile organic compounds (VOCs), and pesticides. In these studies, approximately 500 volunteer participants were randomly selected from three areas of the U.S.: Arizona, the Baltimore, MD area, and EPA Region 5 states (IL, IN, MI, MN, OH, and WI). These studies measured both direct exposures to environmental pollutants and biological indicators of exposure (biomarkers) in their blood or urine. The data from these studies are being analyzed to characterize differences in exposure between demographic groups, to compare exposure measurements and the biomarkers, and to evaluate changes in exposures over time.

Results and Implications

Results from the Arizona study indicate that metals and particulate matter levels were generally higher in lower-income households and those with Hispanic ethnicity. The Arizona study results also suggest that environmental measurements are better predictors of exposure than are questionnaires or

activity information alone. The Baltimore, MD, study found evidence of substantial changes in dietary and drinking water exposures to metals and pesticides over a one-year period. Changes were also found in drinking water and beverage consumption patterns. These results have implications regarding the use of one-time measurements to estimate or classify long-term (chronic) exposures. Their study results also show that dietary exposures occur to more than one Organophosphate (OP) pesticide, which may be important in assessing cumulative risks for these pesticides. In the Region 5 study, relationships among pathways, media, and routes of exposures for metals were strongest for the air measurements. Personal air concentrations were more closely related to indoor- than to outdoor-air measurements. The biomarkers were most closely related to solid food for arsenic, and to surface dust for lead. Concentration measurements were more strongly associated with exposures than were questionnaire items. The implications of these results for future studies include the need to collect a range of measurements for each participant, the need to include non-residential environments in the study, and the need to correlate the timing and duration of environmental measurements relative to the period covered by the exposure and biomarker measurements.

This research project directly supports EPA Office of Research and Development's research to improve the scientific foundation of human health risk assessment under GPRA Goal 8 (Sound Science, Improved Understanding of Environmental Risk and Greater Innovation to Address Environmental Problems), Objective 2 (Research for Human Health Risk Assessment), Sub-Objective 1 (Human Health Research). The results of this project address GPRA Annual Performance Goal (APG) 03 (By 2000, develop initial measurements, methods and models to evaluate exposures and effects of environmental contaminants, particularly in children), Annual Performance Measure (APM) 665 (Report from NHEXAS studies identifying relationships between questionnaire, activity pattern, and contaminant concentrations to personal exposures of chemicals). Although this work directly supports a Goal 8 APM, the results also will be valuable to reduce uncertainties in exposure assessment under GPRA Goal 3 (Safe Food, Research to Support New Regulatory Requirements Under FQPA).

Research Collaboration and Publications

The NHEXAS analysis projects were conducted under Contracts from EPA's National Exposure Research Laboratory and Emory University, Research Triangle Institute, and the University of Arizona.

This research has been presented in several conference presentations, and in the following manuscripts and articles.

Clayton, C.A., Pellizzari, E.D., Quackenboss, J.J. National Human Exposure Assessment Survey (NHEXAS): Analysis of exposure pathways and routes for arsenic and lead in

EPA Region 5. *Journal of Exposure Analysis and Environmental Epidemiology*. Submitted.

Lebowitz, M.D., O'Rourke, M.K., Rogan, S., Reses, J., VandeWater, P., Blackwell, A., Moschandreas, D.J., Gordon, S., Robertson, G. Indoor and outdoor PM_{10} and associated metals and pesticides in Arizona. *Inhalation Toxicology* 12(Suppl 1):139-144, 2000.

MacIntosh, D.L., Hammerstrom, K.L., Ryan, P.B. Longitudinal exposure to selected pesticides in drinking water. *Human and Ecological Risk Assessment* 5: 575-588, 1999.

MacIntosh, D.L., Kabiru, C., Scanlon, K.A., Ryan, P.B. Longitudinal investigation of exposure to arsenic, cadmium, chromium, and lead via beverage consumption. *Journal of Exposure Analysis and Environmental Epidemiology* 10: 196-205, 2000.

Moschandreas, D.J., Kim, Y., Karuchit, S., Ari, H., Lebowitz, M.D., O'Rourke, M.K., Gordon, S., Robertson, G. Occurrence and distribution of residential exposure to chlorpyrifos and diazinon. *Atmospheric Environment*. Submitted.

Moschandreas, D.J., Karuchit, S., Kim, Y., Ari, H., Lebowitz, M.D., O'Rourke, M.K., Gordon, S., Robertson, G. On predicting multi-route and multi-media residential exposure to chlorpyrifos and diazinon. *Atmospheric Environment*. Submitted.

Moschandreas, D.J., Ari, H., Karuchit, S., Kim, Y., Lebowitz, M.D., O'Rourke, M.K., Gordon, S., Robertson, G. Exposure to pesticides by medium and route: the 90^{th} percentile and related uncertainties. *Atmospheric Environment*. Submitted.

Rogan, S.P., O'Rourke, M.K., Robertson, G. Variability in sample metals concentrations among population subgroups in the national human exposure assessment survey in Arizona. *Environmental Health Perspectives*. Submitted.

Ryan, P.B., Huet, N., MacIntosh, D.L. Longitudinal investigation of exposure to arsenic, cadmium, and lead in drinking water. *Environmental Health Perspectives*. In press.

Future Research

Future analyses of the NHEXAS data will be based on the NHEXAS Data Analysis Strategy, which is currently undergoing revision related to the recommendations provided by the EPA's Science Advisory Board. These are expected to include more detailed and complex types of analyses.

Inquiries about NERL's research to analyze the NHEXAS studies can be directed to:

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